

Benjamin Franklin's Political Arithmetic:
A Materialist View of Humanity



Joyce E. Chaplin



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Dibner Library Lecture | December 13, 2006

Smithsonian Institution Libraries

Washington | District of Columbia

Library of Congress Cataloging-in-Publication Data

Chaplin, Joyce E.

Benjamin Franklin's political arithmetic : a materialist view of humanity / Joyce E. Chaplin.

p. cm. -- (Dibner library lecture)

Includes bibliographical references.

1. Franklin, Benjamin, 1706-1790. 2. Demography--History--18th century. 3. Materialism. I. Title.

E302.6.F8C465 2008

973.3092--dc22

2008034471

a about the author c

Joyce E. Chaplin is James Duncan Phillips Professor of Early American History at Harvard University. She received her B. A. at Northwestern University, her M. A. and Ph.D. at the Johns Hopkins University, and was a Fulbright Scholar to the United Kingdom in 1985-86. She has taught at five universities on two continents and an island, as well as in a maritime studies program on the Atlantic Ocean. Her most recent book, *The First*



Joyce E. Chaplin

Scientific American: Benjamin Franklin and the Pursuit of Genius (2006), was a finalist for the Los Angeles Times Book Prize and won the Annibel Jenkins Biography Prize of the American Society for Eighteenth Century Studies. She is currently writing a history of around-the-world travel, from Magellan the Spanish explorer to Magellan the GPS.[†]

[†] I am very grateful to David Armitage, Peter Buck, and John Huffman for their comments on and assistance with this essay.

a forewordc

According to the U.S. Census Bureau's website, on June 25, 2008, the U.S. population was 304,433,726 and the world population was over 6.7 billion. The Population Clock ticked upwards as I watched. Population statistics can now be counted by the second, which makes Benjamin Franklin's "political arithmetic" all the more remarkable. In the 2006 Dibner Library Lecture, Professor Joyce E. Chaplin describes Franklin's interest in human



[figure 3] Benjamin Franklin, 1777.

nature and population growth and how, with far fewer sophisticated tools, he came to the amazingly accurate theory that the North American population was doubling every twenty years. Chaplin's narrative is both a joy to read and highly informative.

The Chaplin lecture on December 13, 2006, is the sixteenth in the series celebrating the collections of the Dibner Library of the History of Sci-

ence and Technology. Several works cited in the essay are in its holdings, but there is much more. The core comprises 8,000 volumes of rare scientific and technological works dating from the fifteenth to the nineteenth centuries in mathematics, engineering, transportation, chemistry, physics, electricity and astronomy. In mathematics, the collection resonates with published works from well-known early scientists, such as Euclid on geometry, John Napier on logarithms and the calculating machine, Gottfried Wilhelm Leibniz on differential calculus, Leonhard Euler who was the founder of modern fluid dynamics, and Carl Friedrich Gauss on the theory of numbers.

Bern Dibner (1897-1988) donated the core collection from his Burndy Library on the occasion of the United States Bicentennial celebration in 1976. The Dibner Library's holdings have expanded to 35,000 rare books and 2,000 manuscript groups. Located in the National Museum of American History, Behring Center, the Dibner Library glitters among the twenty libraries of the Smithsonian Libraries system and annually draws scholars from around the world to investigate the early modern period.

We thank The Dibner Fund for supporting the lecture series and its publications. Libraries staff, including Susan Frampton, Kirsten van der Veen, Mary Augusta Thomas, and editor/designer Elizabeth Periale contributed to the publication. Most of all, we thank Dr. Chaplin who worked closely with us on her manuscript, ensuring its excellence in every way. We hope you enjoy it.

For more information on the Dibner Library of the History of Science and Technology visit www.sil.si.edu/libraries/Dibner/index.cfm.

Nancy E. Gwinn

Director

Smithsonian Institution Libraries

June 2008

Benjamin Franklin's Political Arithmetic:

A Materialist View of Humanity

BE A BEAST, Benjamin Franklin counseled his panic-stricken friend, Oliver Neave, when the poor man was trying to learn how to swim. Neave had to put the dangers of deep water out of his mind—the less conscious reflection, the better. “Though we value ourselves on being reasonable knowing creatures,” Franklin warned, “reason and knowledge seem on such occasions to be of little use to us; and the brutes to whom we allow scarce a glimmering of either, appear to have the advantage of us.” Franklin offered his advice in the 1760s, when comparing humans to brute animals was for him an old habit. The seriousness with which he took the comparison is apparent in his grammatical lapse: “brutes to whom” rather than “brutes to which.” Many aspects of Franklin’s scientific thought are well-known but not, surprisingly, his materialist implication that people, no less than animals or even plants, were physical bodies embedded in nature, whose so-called higher qualities were overrated.¹

It was a radical idea. Perhaps because Franklin took little interest in the eighteenth century’s other materialist conception of humans—that they (like animals) were mere collections of mechanical phenomena, virtual machines—his opinion has been little noted. Yet it mattered. The conventional belief among Franklin’s contemporaries was that humans and animals were different because the former had souls, reason, and finer

emotions. Throughout his life, Franklin was skeptical that any of that was true.²

After brashly advertising his skepticism in his youth, he thereafter masked it. He nevertheless managed to make it into the centerpiece of his political arithmetic, his analysis of population dynamics in British America, which eventually underpinned his boldest objections to the centralized governance of the British empire. Scholars have noted the importance of Franklin's political arithmetic to the development of the human sciences, as well as its impact, via Thomas Malthus, on the Victorian evolutionists Alfred Russel Wallace and Charles Darwin. But to appreciate that impact fully, we should see how Franklin's political arithmetic was read and circulated and see that his efforts were not only part of the human sciences, but part of the natural science within which Wallace and Darwin worked, not least because his assessment, like theirs, daringly assimilated humans to other living creatures.³

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Political arithmetic was, in the eighteenth century, a relatively new field, only about a generation older than Franklin himself. In England, the field's earliest investigators had studied population by examining London's Bills of Mortality, the lists of the dead produced in the city since the sixteenth century. From these lists, analysts extrapolated the size of the total population during ordinary times, or calculated death rates by parish or other variables during times of epidemics. In 1662, John Graunt published his *Natural and Political Observations made upon the Bills of Mortality*, which is often cited as the foundation of modern demography. Subsequent

innovations followed: in the 1680s, William Petty *[figure 4]* defined “political arithmetic” as the study, using numbers, of matters of state; slightly later, Edmond Halley developed the life expectancy table, on which actuarial work would be based; still later, medical analyses, as of inoculation, relied on studies of affected populations. By the time Franklin was an adult, some of political arithmetic’s questions merged with the slightly newer field of political economy and would enter political debates on both sides of the Atlantic.⁴

If the field had an old-world ancestry, it quickly acquired a strongly colonial character. William Petty had notably used political arithmetic to examine the English plantations in Ireland. Meanwhile, across the Atlantic,



[figure 4] Sir William Petty, 1696.

censuses and examinations of the populations of the English colonies were strikingly frequent, probably because of an early uncertainty that the English would survive a new world environment. (The fragile early settlement at Jamestown seems to have had the

most carefully counted population in the early modern English-speaking world.) Between 1623 and 1776, no fewer than 124 colonial censuses were undertaken and covered 21 of the British colonies on the continent and in the Caribbean islands; this total would not even include all the local histories, governors' reports, militia musters, town bills of mortality, newspaper accounts, and hundreds of other sources that estimated population. Colonists were a remarkably enumerated people.⁵

Franklin's interest in political arithmetic was long-standing. His earliest engagement with the field came in 1722, when he was sixteen and sent some anonymous letters to his brother, James Franklin, to whom he was apprenticed as a printer in Boston. These contributions were, of course, Franklin's famous "Silence Dogood" letters, in which he posed as a puritan widow whose wit enlivened James Franklin's newspaper, the *New-England Courant*. In one of "her" missives, the Widow Dogood recommended an "*Office of Ensurance for Widows*," which would grant a premium to a widowed woman according to the payments her husband had made and calculated against his age at death. Mrs. Dogood did not acknowledge that her plan had already appeared in London, there authored by Daniel Defoe, though she did cite "Sir William Petty in his *Political Arithmetick*" to support her suggestion [figure 5]. Her scheme made it clear that her creator, Benjamin Franklin, had been reading in political arithmetic, including Defoe and Petty, by the time he was fifteen or sixteen years old.⁶

The usual narrative of Franklin's engagement with political arithmetic would, at this point, skip ahead to the year 1729, when Franklin next published a piece that cited Petty. But an essay of 1725 had even greater

S. High, London, 1699. 12
Re

SEVERAL
ESSAYS
IN
Political
Arithmetick:

The Titles of which follow in the
Ensuing Pages.

BY
Sir WILLIAM PETTY,
Late Fellow of the Royal Society.

L O N D O N :

Printed for Robert Clavel at the Peacock,
and Henry Mortlock at the Phoenix in St. Paul's
Church-Yard. 1699.

[figure 5] Petty's Several Essays..., 1699.

importance for his subsequent writings on political arithmetic. This was a work of philosophy, Franklin's first major publication, and one that he claimed to regret more than anything else he ever wrote.

Franklin was inspired to write the piece after he had run away from his brother's service in Boston, tested the market for printers in Philadelphia, and then migrated to London, where he worked in two metropolitan printshops and read everything he could get his hands on. (London evidently gave him his earliest exposure to natural science.) In 1724, he helped his second London master print a third edition of a religious work, William Wollaston's *The Religion of Nature Delineated*. Wollaston presented, in classic Deist fashion, a rationally-ordered world in which even the wildest parts of nature followed a divine plan. Providence had ensured, for example, that "plants and animals [had] subsistence *set out* for them; and as they go off, successors [are] appointed to relieve them, and carry on the *scheme*, etc." Thus did nature exhibit wonders that should inspire faith in God and the moral actions that would lead humans back to Him. Wollaston's title page bore an image of a printing house, with printers at work under the Latin motto "VITAM MORTUIS REDDO," which meant "I restore life to the dead." This phrase, Christ's promise to humanity, was an apt ornament for a printed work of religion which argued that even death could not defeat providential order.⁷

Unconvinced, Franklin wrote a rebuttal. The title of his work, *A Dissertation on Liberty and Necessity, Pleasure and Pain* [figure 6], announced his view that humans did not behave well because they learned morality from the physical nature that they could see around them. Instead, their own physical nature supplied impulses, especially the desires to experience pleasure

A
DISSERTATION
ON
Liberty and Necessity,
PLEASURE and PAIN.

*Whatever is, is in its Causes just
Since all Things are by Fate; but purblind Man
Sees but a part o' th' Chain, the nearest Link,
His Eyes not carrying to the equal Beam
That poises all above.*

Dryd.



LONDON:
Printed in the Year MDCCXXV.

[figure 6] Franklin's Dissertation on Liberty..., 1725.

and to avoid pain, which might have beneficial outcomes. To some extent, Franklin followed Wollaston's Deist arguments. He carefully acknowledged the existence of a divine creator, for instance, and argued that the creation governed itself according to physical laws that had been set into motion at the start of earthly history. "Thus is the Machine set on work; this is Life."⁸

But Franklin did not give human life a higher sense of purpose, one that accepted the existence of an immortal soul that strove to return to God. Rather, he emphasized that all human action resulted from physical sensation. In this, he veered toward materialism and atheism. Although he had read John Locke's *Essay Concerning Human Understanding*, which suggested that matter itself might have the power to cogitate (thus rendering the human soul irrelevant), Franklin emphasized physical sensation rather than thought as the source of human actions. While he did discuss pleasure, as the title of his work had promised, he put somewhat greater emphasis on pain as a motivating factor. "We are first mov'd by *Pain*," he argued, "and the whole succeeding Course of our Lives is but one continu'd Series of Action with a View to be freed from it." Without pain, the entire "Animal Creation" would "stand stock still," as if reduced to the condition of motionless statues. The sensation of pleasure was "*in exact proportion*" to that of pain and, together, the two sensations accounted for human acts, even those with seemingly cerebral motivations, and even those with moral implications.⁹

His readers would have recognized Franklin's text as libertine, meaning that it did not regard the prospect of divine justice, especially the punishments or rewards meted out after death, as important constraints on human actions. The form of his text was also satirical—it parodied the

logical flow characteristic of works of religious philosophy without respecting their content. Franklin's essay did not consider the ultimate destiny of the human soul, for example, which religious works would have done. And he downplayed the human reason that other moral philosophers, such as Francis Hutcheson, had stressed and would stress in similar works.¹⁰

All in all, Franklin gave the impression that he considered men and women to be comparable to animals, as creatures endowed only with sensate bodies, not moral souls. Indeed, he stated that "every Creature must be equally esteem'd by the Creator." That was deeply repellent to most of his contemporaries, and the fact that Franklin assaulted conventional arguments for the immortality of the soul and the likelihood of an afterlife would not have consoled readers who hoped that these were the very things that differentiated them from all other natural beings. In his final paragraph, Franklin jeeringly anticipated one possible response to his arguments: "What! bring ourselves down to an Equality with the Beasts of the Field! with the *meanest* part of the Creation! 'Tis insufferable!" To which Franklin answered, "Truth will be Truth tho' it sometimes prove mortifying and distasteful."¹¹

Those were Franklin's last words on the matter, which he then followed with the emblem of the print-shop under the same motto *vitam mortuis reddo* that had opened Wollaston's essay [see page 16, figure 7]. The picture made Franklin's satirical object apparent, as well as his desire to reverse or even upend the Christian tradition. Which dead bodies did he think could be restored to life? Did he mean to imply, on his final page, that animals were as likely to be resurrected as humans or (equally offensive to the orthodox) that

meet with but an indifferent Reception. Mankind naturally and generally love to be flatter'd: Whatever soothes our Pride, and tends to exalt our Species above the rest of the Creation, we are pleas'd with and easily believe, when ungrateful Truths shall be with the utmost Indignation rejected. "What! bring ourselves down to an Equality with the Beasts of the Field! with the *meanest* part of the Creation! 'Tis insufferable!" But, (to use a Piece of *common* Sense) our *Geese* are but *Geese* tho' we may think 'em *Swans*; and Truth will be Truth tho' it sometimes prove mortifying and distasteful.



[figure 7] Image of a printing house closing Franklin's essay.

humans were no more likely than animals to achieve an afterlife? Works that were not nearly as materialist as Franklin's got their authors imprisoned. To escape prosecution, Franklin printed neither his name nor the name of the print-shop on his pamphlet. (The dedicatee, James Ralph, was surely relieved that Franklin indicated him only by the initials "J. R.") Author and printer could not be traced, and thus eluded the authorities.¹²

Bold at age nineteen, when he paid his London master to have 100 copies of the satirical work printed, Franklin later lost his nerve. He never publicly restated the materialist philosophy of his *Dissertation*. He instead became outspoken in his acceptance of the argument from design, the idea that the creation was so wondrous and complex that it had to be the handiwork of a Supreme Being. He also publicly accepted the orthodox belief that the human soul would survive death, a fate denied to all other earthly beings. In his 1728 "Articles of Belief and Acts of Religion," written three years after he had published the *Dissertation on Liberty and Necessity*, he emphasized that God had "created Man, bestowing Life and Reason, and plac'd him in Dignity superior to thy other earthly Creatures."¹³

Franklin claimed to have burned all but one copy of his *Dissertation*. Seven of the hundred copies are known to have survived, however—not bad for an early eighteenth-century print run of that size—so Franklin was not as assiduous as he asserted. (Whether he knew it or not, a subsequent edition of 1733 came out in Dublin, so the circulation of his parody was if anything increasing.) His claim to have destroyed his juvenilia nevertheless shows his effort to distance himself from it. In his memoirs, Franklin took care to describe the work as an "Erratum," a printer's term for an error in

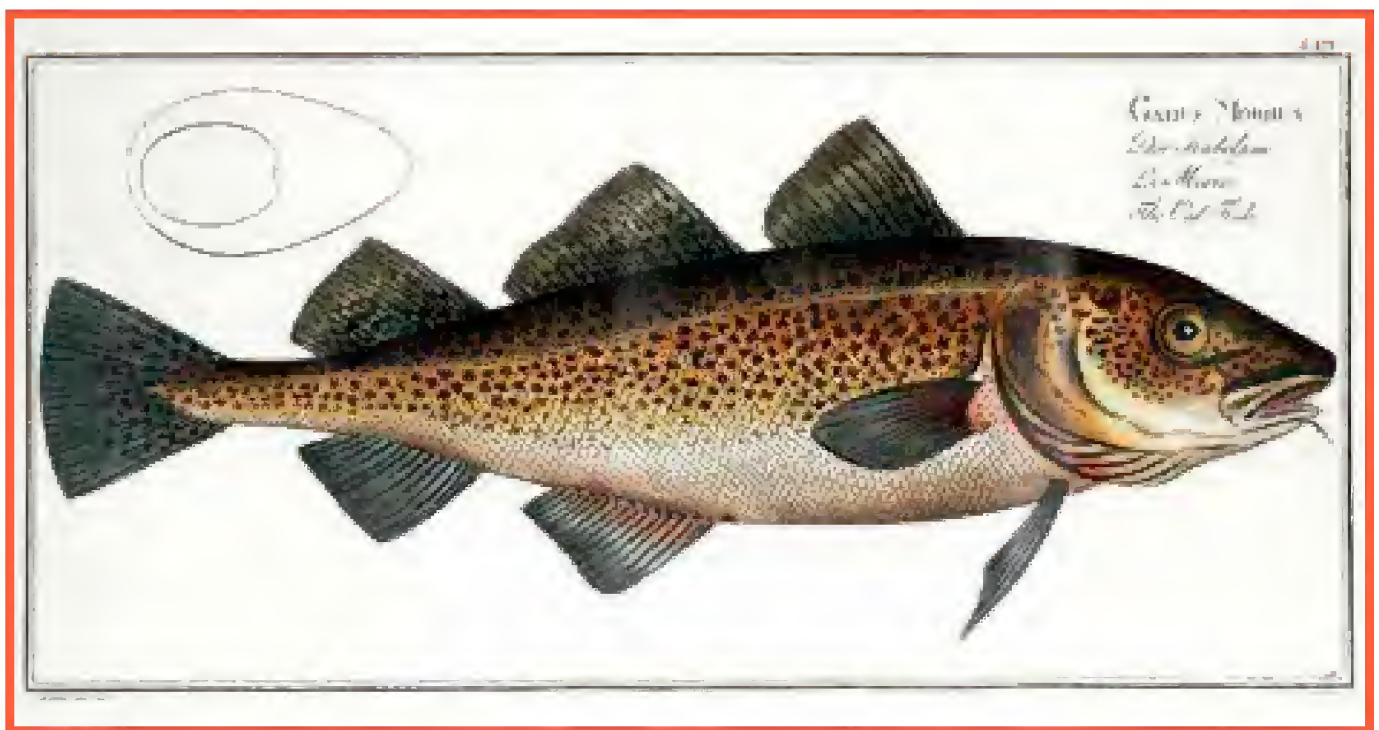
composition, and Franklin's term for the great errors of his life. As has often been noted, this definition of error hints at Franklin's assumption that his mistakes were correctible, things he could easily change in the next draft.¹⁴

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But it is not clear that Franklin himself had changed. To be sure, he had little taste for mechanist conceptions of humanity. On only three occasions after his *Dissertation on Liberty and Necessity* do his surviving writings compare the human body to a machine (and the only time in earnest was in French). But he retained an interesting habit of comparing humans to the rest of creation, especially to animals. At times, he referred to the concept of the Great Chain of Being, in which humans existed in a category somewhere between that of animals and of the Supreme Being. At other times, however, Franklin did not distinguish between the animal and human states. For example, he used the behavior of carnivores to justify his renunciation of a vegetarian diet. He had forsworn meat for a short time in his youth, mostly to save money with which to buy books. But he was sorely tempted, on a short boat journey down the North American coast, when his fellow passengers caught some cod and prepared it to eat [figure 8]. "When this came hot out of the Frying Pan," Franklin reminisced in his memoirs, "it smelt admirably well." He wavered "between Principle and Inclination: till I recollected, that when the Fish were opened, I saw smaller fish taken out of their Stomachs." "If you eat one another," Franklin decided, "I don't see why we mayn't eat you." He added a sarcastic assessment of the capacity that was supposed to differentiate humans from animals: "So convenient a thing it is to be a *reasonable Creature*, since it enables one to find or make a Reason for every

thing one has a mind to do.”¹⁵

As he established himself as a printer in Philadelphia, where he settled after he left London in 1726, Franklin used political arithmetic to fill out his earliest publications. In his newspaper, the *Pennsylvania Gazette*, for instance, he published population statistics for the city of Philadelphia, comparing it to other urban centers in Europe and in British America. At several points, he focused on the dangers of disease, especially smallpox, and calculated the values of the free versus the enslaved laborers who had died in epidemics. He also cited William Petty’s *Treatise of Taxes and Contributions* (1662) in his *Modest Enquiry into the Nature and Necessity of a Paper-Currency* (1729), which he wrote to convince the Pennsylvania House of Assembly to print currency in order to facilitate financial transactions for a growing population and economy. (The assembly acceded and gave Franklin the



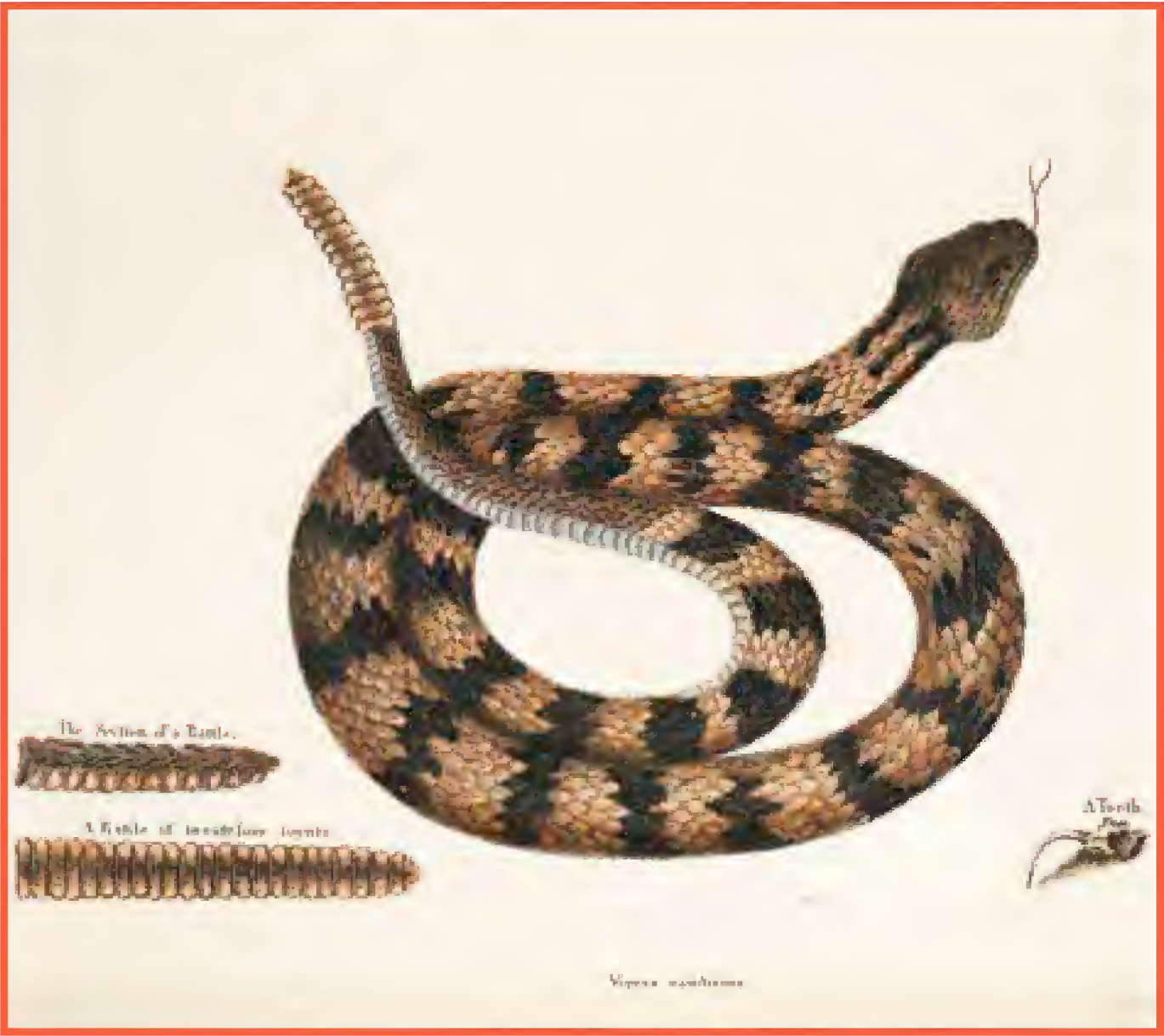
[figure 8] “The Cod Fish,” Marcus Elieser Bloch, *Ichtyologie, ou Histoire Naturelle, Générale et Particulière des Poissons*, 1785-97.

license to print the money.) Finally, Franklin helped to create Philadelphia's Union Fire Company, which was essentially an insurance company, one that calculated the risk of fire against the numbers of those who had paid into the scheme.¹⁶

Franklin fashioned his major contributions to political arithmetic during the 1750s. In 1750, he used his expanded almanac, *Poor Richard Improved*, to argue that the colonies no longer needed immigrants. He noted how English commentators had estimated that the continental colonies doubled their population every thirty years, but explained that those experts assumed migration accounted for most of the growth. Franklin accepted the estimate but proposed a different cause. "I believe People increase faster by Generation in these Colonies, where all can have full Employ, and there is Room and Business for Millions yet unborn." That advantage was in contrast to the "old settled Countries" which offered no such opportunities.¹⁷

Franklin pointed to "Breslaw" as an old place with limited population growth. His unusual choice of example—a far-off eastern European city he would know little about—revealed the work of political arithmetic he had evidently consulted: Edmond Halley's "An Estimate of the Degrees of Mortality of Mankind." Published in the *Philosophical Transactions* of the Royal Society of London in 1693, Halley's essay had analyzed Breslau's bills of mortality. Evidently, when Franklin compared those statistics to his knowledge of Philadelphia—and quite possibly his general sense of British America's overall population—he glimpsed a remarkable contrast between the old world and the new, and began to distrust Europe's political arithmeticians.¹⁸

The following year, 1751, Franklin published in the *Pennsylvania Gazette* an even sharper attack on British assumptions that the colonies needed Britain for their population growth. Irritated that British ministers still viewed the colonies as a dumping ground for unwanted people, even convicted felons, Franklin proposed an exchange: British convicts for American rattlesnakes. The reptiles could be comfortably resettled in English gardens [figure 9]. Their danger was exaggerated, Franklin claimed,



[figure 9] A rattlesnake, from Mark Catesby, *The Natural History of Carolina, Florida and the Bahama Islands*, 1731-43.

reversing, for comic effect, the usual ranking of humans and animals: “What is a *Child* now and then kill’d by their venomous Bite,—or even a favourite *Lap-Dog*?”¹⁹

By 1751, Franklin was also working on a longer analysis of American population, his “Observations Concerning the Increase of Mankind.” For this essay, he sharpened his point about the difference between the populations of British America and of Europe. His title indicated a continued critique of Halley’s similarly-titled “Estimate of the Degrees of Mortality of Mankind,” especially in its replacement of “Mortality” with “Increase,” already a boast about Americans’ greater vigor. Franklin opened his essay, moreover, with the protest that estimates of population that used “Bills of Mortality” would not “suit new Countries, as America.” The typical ratio of deaths to births did not apply to the continental colonies. That was the case because America had greater availability of land, which permitted people to marry sooner and produce more children than was the case in old countries, where the working poor—meaning the majority of people—could not so easily afford to maintain households.²⁰

Franklin now modified his earlier estimate that the colonial population was doubling every thirty years—he concluded that it did so every twenty years, exclusive of immigration. And he fantasized, notoriously, about a cultural and racial homogeneity that might thus be created in British America. He claimed that Europeans made “the principal Body of White People on the Face of the Earth” and wished that they would increase. In North America, he promised, “we have so fair an Opportunity [to do so], by excluding all Blacks and Tawneys,” meaning Africans and Indians, and by

“increasing” those of European ancestry, who had complexions of “the lovely White and Red” mixed together.” Not even all those with white-and-red complexions were welcome. Franklin complained about the German “Boors” who would, without any bar against them, “swarm into our Settlements,” along with their alien language and manners.²¹

Yet in these criticisms of Africans, Indians, and Germans, Franklin used naturalized imagery to urge the decline of only one group, the Indians. However offensive his comments about African complexions, his main objection to slaves was economic; they were an expensive and unnecessary source of labor, given the constant growth of the pool of free workers in the continental colonies. And his dominant prejudice against Germans was cultural. He believed them to be of the same blood stock as Britons but deplored their tendency to retain their language and culture in America—he was virulently ethnocentric, but did not believe Germans to be physically different from people of English ancestry.²²

In contrast, Franklin based his prejudice against Indians on their perceived physical difference. He would later criticize colonists’ violent attempts to take land from Indians. But he also wrote that Indians were unusually susceptible to smallpox and to alcohol, two factors that hinted at their imminent demise. Or, as Franklin [figure 10] put it late in life, they would be “annihilated,” as if so many weeds that temporarily overran land that white settlers were destined to cultivate. Although Franklin never used the word *extinction* to describe Indians’ presumed fate, and despite his incredulity (when confronted with fossils) that any species of plant or animal could ever completely disappear, his discussion of Native Americans remained

exceptional in its suspicion that they might well vanish.²³

The white people who would replace Indians were, for Franklin, a vast natural resource and the real future of the British empire. Colonists would, for instance, form “a glorious Market” for British manufactures.



[figure 10] Benjamin Franklin, c. 1780.

British officials should welcome the natural increase of colonial people as “an Accession of Power to the British Empire by Sea as well as Land! What Increase of Trade and Navigation! What Numbers of Ships and Seamen!”²⁴

Historians have generally agreed that Franklin’s *Observations Concerning the Increase of Mankind*, when published (anonymously) in London in 1754,

was a colonial protest against imperial politics. And Franklin's contemporary criticisms of British ministers, for exporting felons to America and for regulating American manufacturing, amply support that interpretation; angry over Britain's view of the colonies as a convenient repository for undesirables and as a protected market for manufactures, Franklin warned that the colonists would soon outnumber their rulers. The imperial politics of the early 1750s were indeed the perfect context for Franklin's writings. His later decision to eliminate the parts of the essay that insulted anyone who was not British (including the Pennsylvania Germans who helped vote him out of office in 1764) only highlighted his political instincts and aspirations.

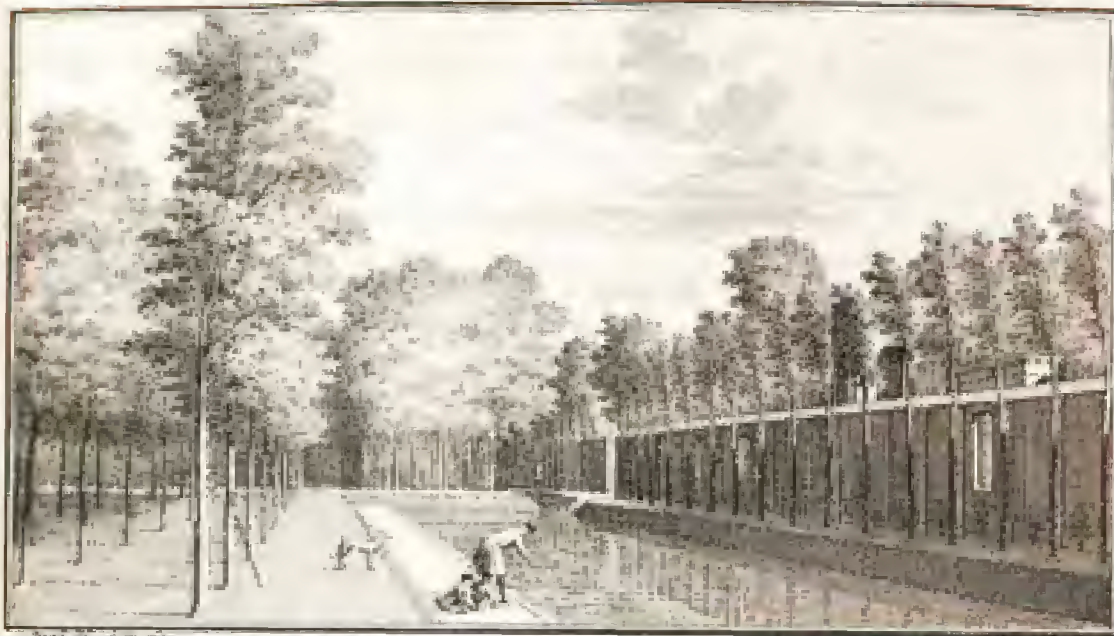
But Franklin's analysis of human population was also inspired by work in natural science, as his comparisons between humans and other natural creatures made clear. Although American population increase depended upon the average age at marriage, meaning human decisions about when to marry, Franklin did not analyze the reasoning behind those decisions—he presented them as self-evident. Much as his *Dissertation on Liberty and Necessity* had focused on two physical sensations, pleasure and pain, so his political arithmetic privileged two physical impulses, hunger and sexual desire. Nothing, he said, would check the “prolific Nature of Plants or Animals, but what is made by their crowding or interfering with each others Means of Subsistence.” Without the deprivation that such crowding created, reproduction soared. He offered a hypothetical example. “Was the Face of the Earth vacant of other Plants, it might be gradually sowed and overspread with one Kind only; as, for Instance, with Fennel; and were it empty of other Inhabitants, it might in a few Ages be replenish'd from one Nation only; as,

for Instance, with Englishmen.”²⁵

Even more arrestingly, Franklin compared Britain to a polyp, the small aquatic creature that Swiss naturalist Abraham Trembley had recently investigated. In 1744, Trembley had published his finding that, when a polyp was dismembered, each disengaged part produced another new animal [figure 11]. So Franklin compared a colonizing nation to “a Polypus.” Just as that creature could survive dismemberment, only to make progeny from its severed limbs, so could a colonizing nation remove parts of its body and see them grow. Thus, he wrote, “you may of one make ten Nations, equally populous and powerful.”²⁶

Franklin’s examples from nature, the humble and low-growing fennel and the nearly invisible and invertebrate polyp, were hardly flattering to the humans they were meant to describe—many other eighteenth-century organic images of human society used nobler creatures. Yet he clearly intended his lowly creatures precisely as naturalistic metaphors. In only one other of his extant writings did Franklin use the words *fennel* and *polyp*: in a short essay on microscopy that he published in *Poor Richard Improved* for 1751. The date of that essay’s publication indicates that Franklin composed the piece around the same time he was working on his essay in political arithmetic—it is even possible that he worked on them concurrently.

Franklin’s essay on the microscope was one of several pieces he placed in his almanac to tell his readers of new discoveries in science. Microscopy had been known since the late seventeenth century, when works such as Robert Hooke’s *Micrographia* [figure 12] had described views of the microscopic world. By the second quarter of the eighteenth century, London instrument makers

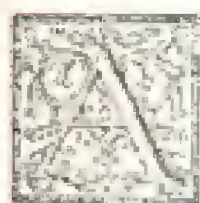


MÉMOIRES POUR L'HISTOIRE DES POLYPES.

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## TROISIÈME MÉMOIRE.

*De la Génération des Polypes.*



**A** PRES m'être assuré, que les Polypes d'eau douce, dont il est question dans ces Mémoires, pouvoient se multiplier par la section, je fus extrêmement curieux de connoître la manière dont ils se multiplient naturellement. Je doutois encore, dans ce tems-là, si les Polypes étoient des Plantes, ou des Animaux, & je  
me

[figure 11] Trembley's work on polyps, 1744.



**MICROGRAPHIA:**  
OR SOME  
*Physiological Descriptions*  
OF  
**MINUTE BODIES**  
MADE BY  
**MAGNIFYING GLASSES.**  
WITH  
**OBSERVATIONS** and **INQUIRIES** thereupon.

---

By **R. HOOKE**, Fellow of the **ROYAL SOCIETY.**

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*Non possis oculis quantum contendere Linceus,  
Non tamen idcirco contemnas Lippus oculos. Horat. Ep. lib. 1.*

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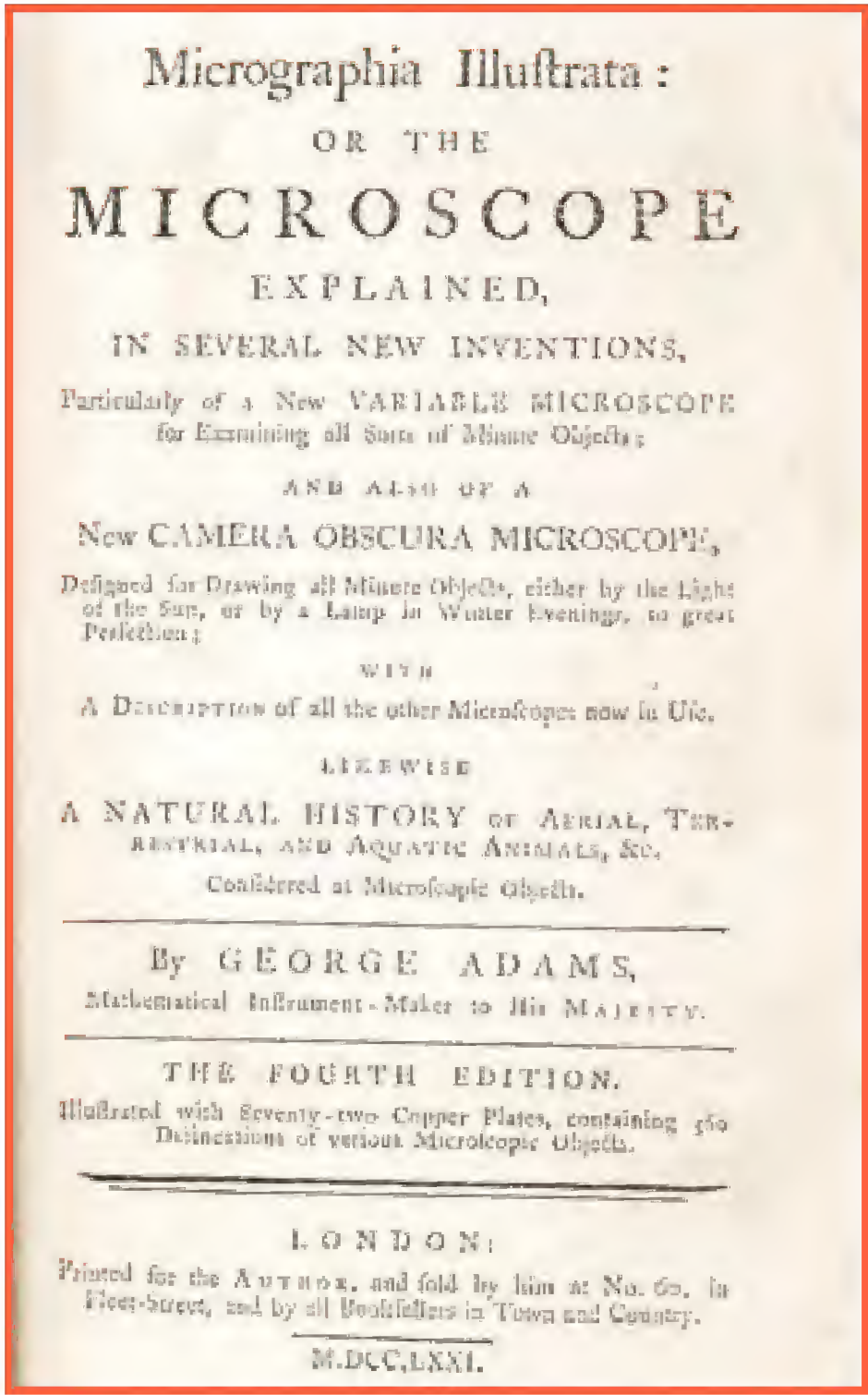
**LONDON**, Printed by **Jo. Martyn**, and **Jo. Allestry**, Printers to the  
**ROYAL SOCIETY**, and are to be sold at their Shop at the Bell in  
S. Paul's Church-yard. **M DC LX V.**

[figure 12] Hooke's Micrographia..., 1665.



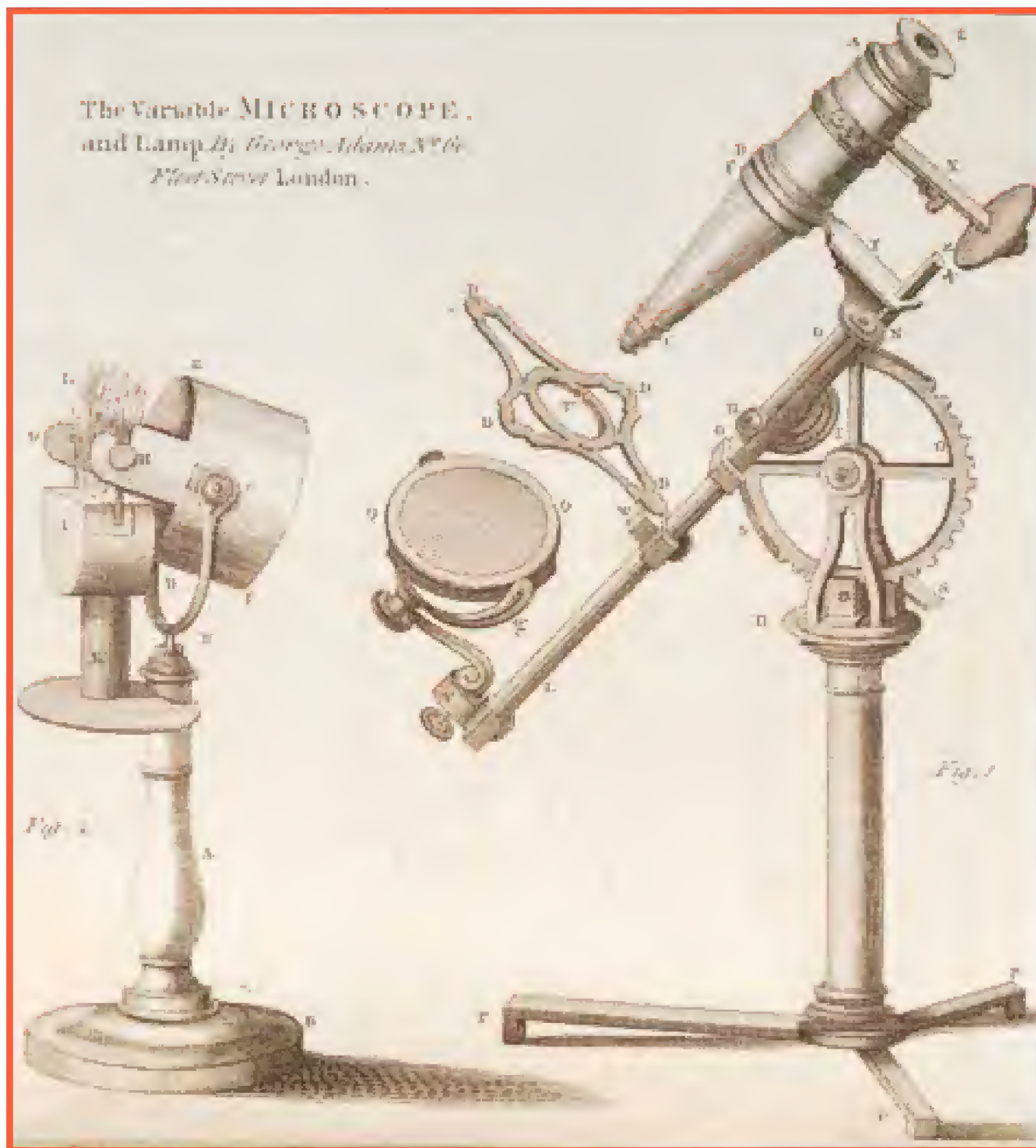
manufactured cheaper versions of microscopes for middle-class consumers. George Adams, for instance, sold scientific instruments as well as texts [figure 13], including his *Micrographia illustrata*, first published in 1746, to tell his customers how to use his devices. Many colonists were such customers. For example, the learned society that Franklin had helped to create, the Library Company of Philadelphia, had owned a microscope since 1741. And somehow Franklin got his hands on an imported copy of Adams's *Micrographia illustrata*, and lifted much of his text from that work.<sup>27</sup>

He encouraged the readers of *Poor Richard* to see for themselves the “remarkably entertaining Objects” to be seen under



[figure 13] Adams's *Micrographia illustrata*, 1771.

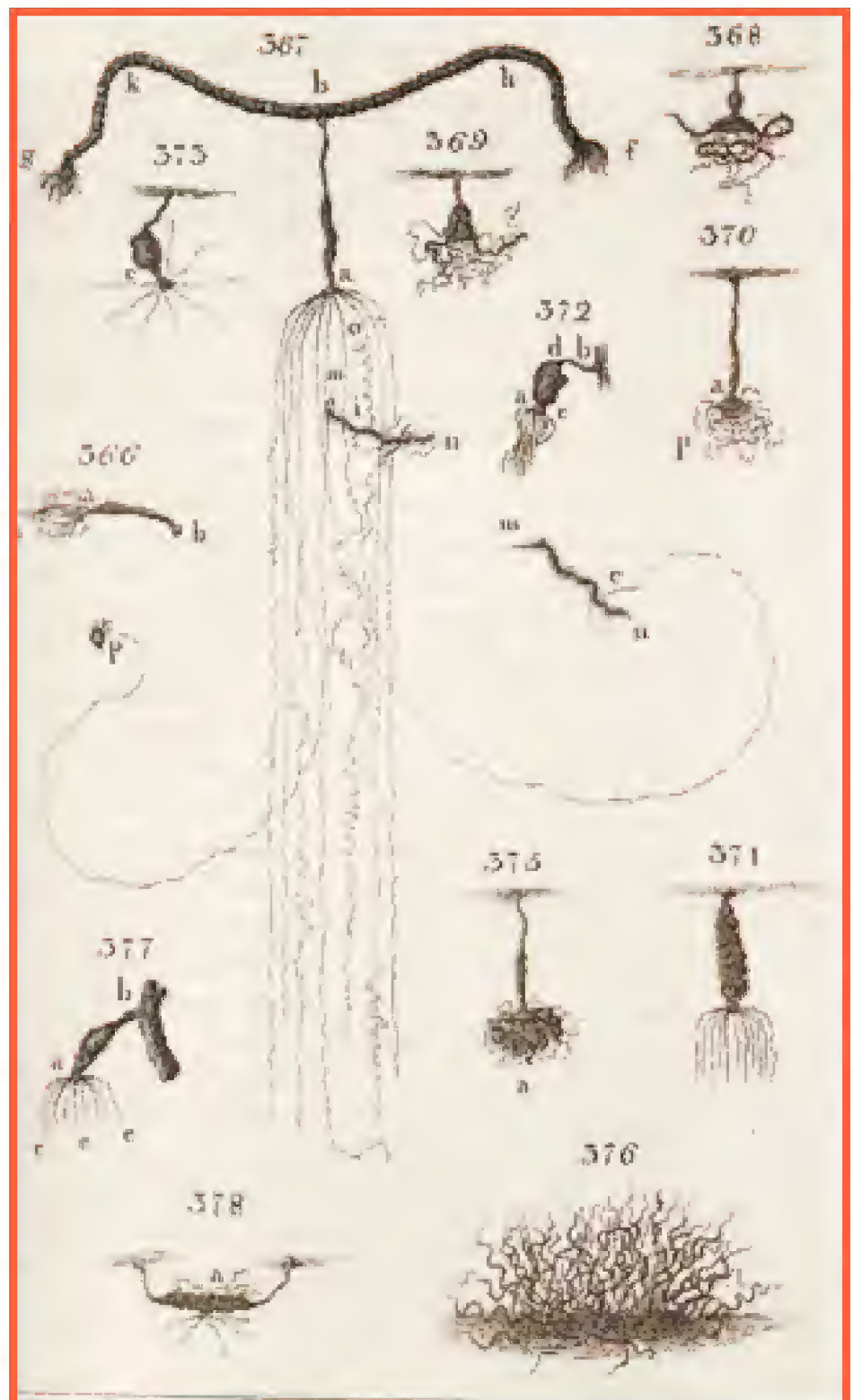
“that admirable Instrument the MICROSCOPE” [figure 14]. The device would show them the tiny “Animalcules to be found...in the Infusions of Pepper, Senna, Pinks, Roses, Jessamin, Tea, Raspberry Stalks, *Fennel*, Sage, Melons,



[figure 14] From Adams's *Micrographia illustrata*.

sour Grapes, Wheat, Hay, Straw, and almost all vegetable Substances.” A microscope would also display a *polyp*, the tiny aquatic creature that Trembley had described [figure 15]. “What is wonderful, and almost beyond Belief,” Franklin said of the creature, “is, that it will live and feed after it is turned inside out, and even when cut into a great many Pieces, each several Piece becomes a compleat Polype.”<sup>28</sup>

Thus inspired to think of colonists as fennel plants and of the first British empire as a many-headed mini-hydra, Franklin also marveled that the teeming hordes within the microscopic world greatly outnumbered the inhabitants of the human world. “In the



[figure 15] Polyps or hydras from Adams's *Micrographia illustrata*.



[s]melt of a single Cod-fish," he explained, "ten Times more living Creatures are contained than the [human] Inhabitants of Europe, Asia, Africa, and America, taking it for granted, that all Parts of the World are as well peopled as Holland, which is very far from being the Case." He explained how another animalcule was so tiny that "three Millions of them, or three Times the Number of the Inhabitants of London and Westminster, would not equal the Bulk of a Grain of Sand."<sup>29</sup>

It was interesting to Franklin that animalcules might outnumber Britons, but crucial for him that colonists would eventually do so. He quickly turned his prediction that Americans doubled their numbers every twenty years into the cornerstone of his criticism of British government of the colonies. His was a powerful voice. Franklin's *Experiments and Observations on Electricity*, first published in 1751 [figure 16], made him the best-known British American of his day. In that magnum opus and all his other work in science, Franklin was careful never to favor one side in any argument. Thus he had not, in his *Observations Concerning the Increase of Mankind*, cited any of the other theorists who considered humans to be mere components of the material world, even though that idea had gained some ground since his youth. He did not mention Carolus Linnaeus's controversial decision, in *Systema naturae*, from 1758, to classify humans alongside the other animals. Nor did he cite Julien Offray de La Mettrie's conclusion, published in 1748, that the human body was, like the rest of nature, a mechanical construction whose material foundation meant humans might well be described as machines.<sup>30</sup>

Even as Franklin avoided publishing any outright statement of materialism, his private correspondence revealed his continued skepticism

EXPERIMENTS  
AND  
OBSERVATIONS  
ON  
ELECTRICITY,

MADE AT

*Philadelphia in America,*

BY

Mr. BENJAMIN FRANKLIN,

AND

Communicated in several Letters to Mr. P. COLLINSON,  
of London, F. R. S.

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L O N D O N :

Printed and fold by E. CAVE, at St. John's Gate. 1751.

(Price 2s. 6d.)

[figure 16] *Franklin's Experiments...*, 1751.

that humans possessed any quality that distinguished them from animals or any other form of matter. His friend, the Reverend Joseph Priestley, who had his own doubts about the immateriality of the human soul, had done chemical experiments using animals. In a dark moment during the Revolutionary War, his regard for humanity at a low point, Franklin reproached Priestley for having “murdered in mephitic air so many honest, harmless mice” and recommended that he start using children instead. And at the very end of his life, Franklin fantasized in several private letters that science might eventually be able to resurrect him, as if he had no faith that divine power could or would accomplish that at the end of days.<sup>31</sup>

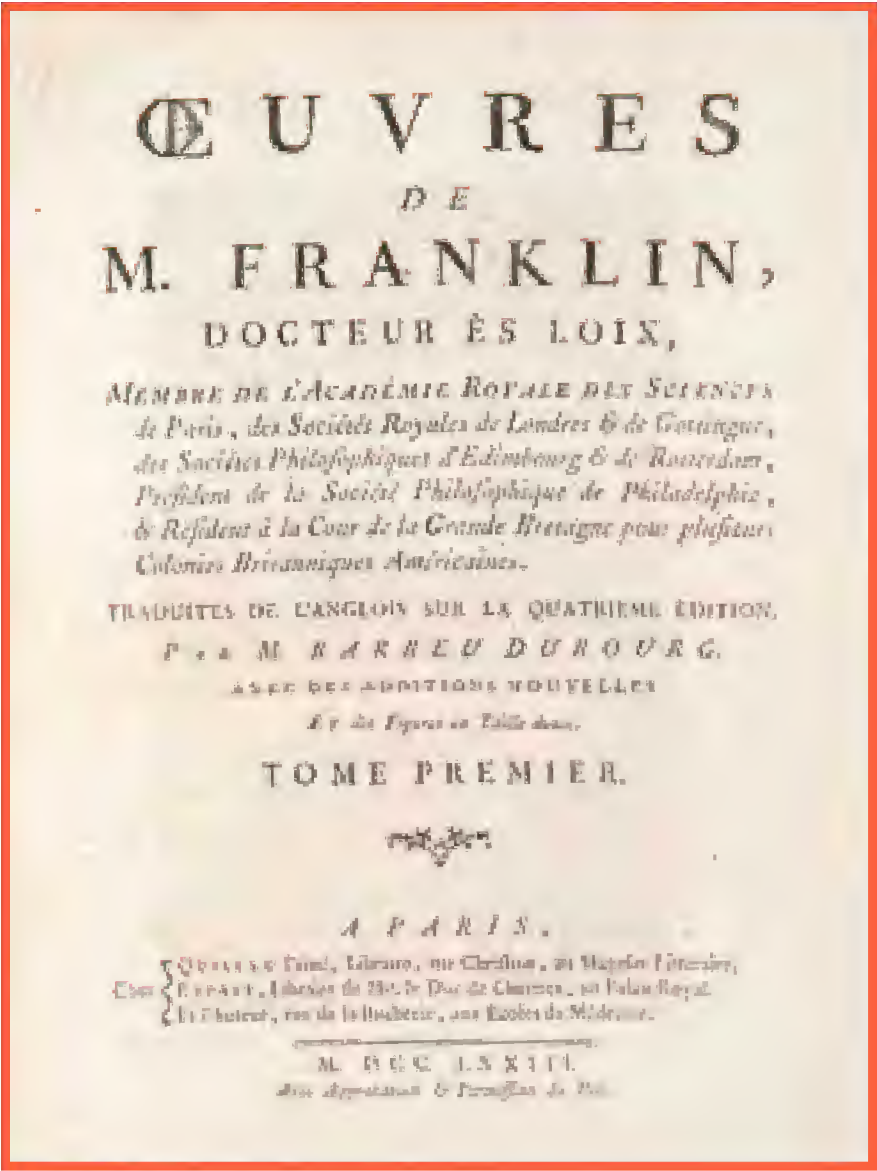
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By not putting any partisan observation about humanity’s material nature into his essay on political arithmetic (as he had done with his *Dissertation on Liberty and Necessity*), Franklin made it more appealing to readers. And, as colonial protests against Britain grew more heated and frequent, he took every opportunity to republish the piece. The next edition came out in 1760, appended to his critique of the prospective treaty to end the Seven Years’ War, *The Interest of Great Britain Considered . . .*. This time, the work appeared under Franklin’s name and on both sides of the Atlantic, in London and Boston. Next he included it in the greatly expanded edition of his *Experiments and Observations on Electricity* (1769), in the largest collection of his writings translated into French, *Oeuvres de M. Franklin* (1773) [figure 17], and in another edition of *Experiments and Observations on Electricity* (1774) [figures 18, 19]. In America, Franklin’s celebration of colonial population heartened patriots; in France, it challenged the idea that America’s nature



caused plants and animals (including humans) to degenerate.<sup>32</sup>

Amazingly, Franklin’s text had its widest circulation in Great Britain. (Britons were evidently fascinated by the possibility that a growing American population might bring down the empire.) In early 1770, Franklin had published a diatribe in London’s *Public Advertiser* against the “wrong-headed Ministry” that sought to tax American colonists: because American colonists were doubling their numbers every twenty years, “merely by natural Population,” they constantly expanded a large and voluntary colonial consumer base that British ministers were foolish to alienate. After the Revolutionary War had indeed alienated all those American consumers, Franklin reminded Britons of their loss. An astonishing compendium of his work, *Political, Miscellaneous, and Philosophical Pieces* (1779) [figure 20] was published in London at the height of the War for Independence and even opened with his



[figure 17] Franklin’s Oeuvres..., 1773.

E X P E R I M E N T S  
A N D  
O B S E R V A T I O N S  
O N  
E L E C T R I C I T Y,  
M A D E A T  
P H I L A D E L P H I A I N A M E R I C A,  
B Y  
B E N J A M I N F R A N K L I N, L. L. D. and F. R. S.  
Member of the Royal Academy of Sciences at Paris, of the Royal Society at Gottingen,  
and of the Batavia Society in Holland, and President of the Philosophical Society  
at Philadelphia.  
To which are added,  
L E T T E R S A N D P A P E R S  
O N  
P H I L O S O P H I C A L S U B J E C T S.  
The Whole corrected, methodized, improved, and now collected into  
one Volume, and illustrated with COPPER PLATES.  
T H E F I F T H E D I T I O N.

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L O N D O N :

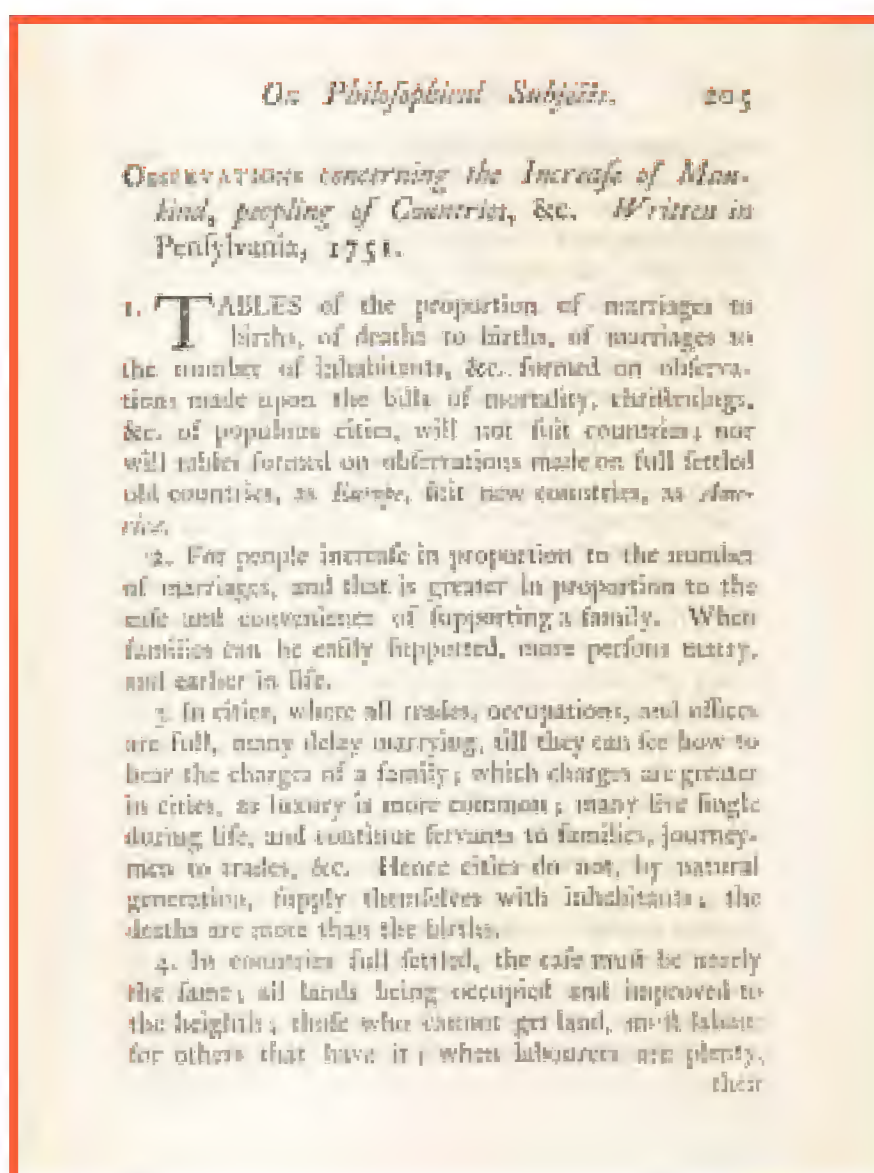
Printed for F. NEWBURY, at the Corner of St. Paul's Church-Yard.

M.DCC.LXXIV.

*[figure 18] Franklin's Experiments and Observations..., 1774 (Expanded Edition).*

essay on population [figure 21]; demand for the work was such that a second edition quickly appeared. Another London collection of his works, published in 1787 [figure 22], after Britain had acknowledged an American victory, featured a subsequent reworking of his demographic conclusions. In this “Advice on Emigration to America,” Franklin told migrants not to expect any assistance for their resettlement because they were not, strictly speaking, needed.<sup>35</sup>

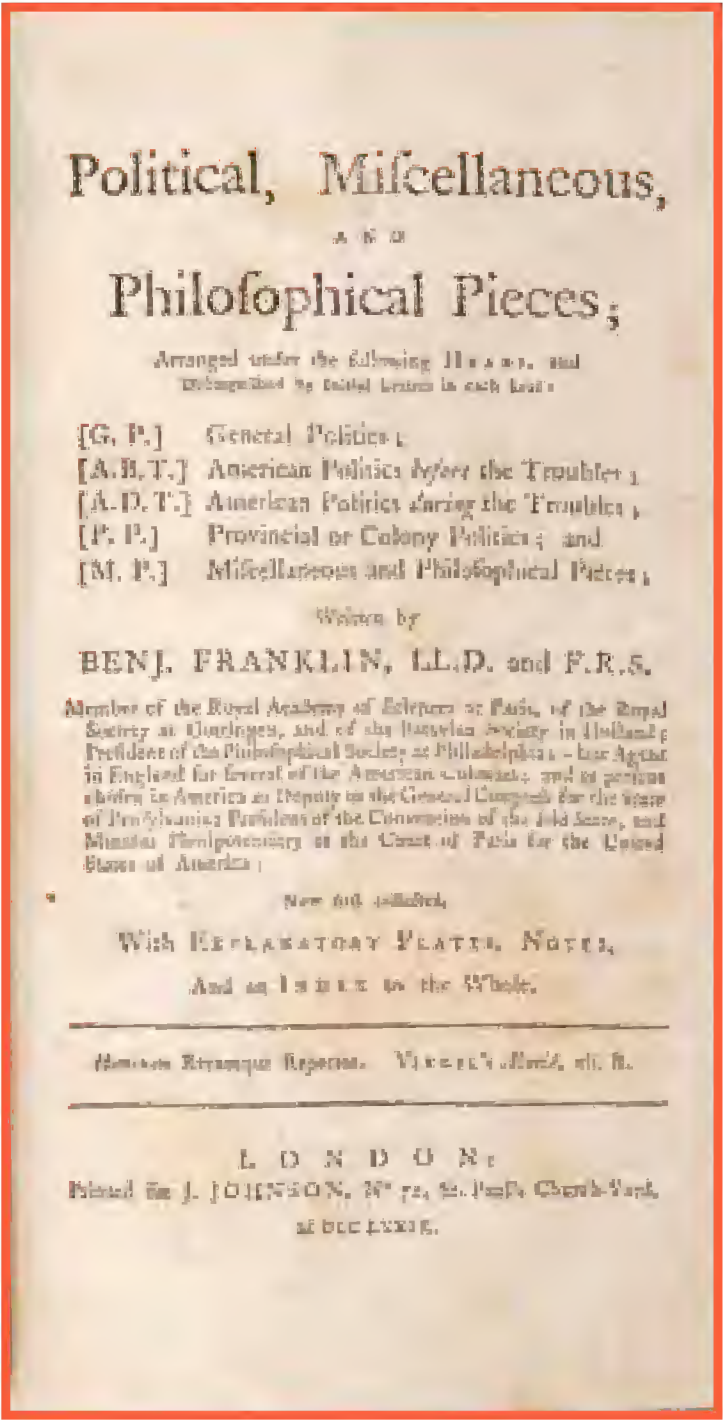
On both sides of the Atlantic Ocean, Franklin’s conclusion that North America’s population was doubling every twenty years was gospel. Indeed, it became a commonplace, meaning that it was widely cited yet done so increasingly without attribution—a bittersweet outcome for any author. New England clergyman and educator Ezra Stiles did quote “Dr. FRANKLIN” in a published sermon of 1761, to the effect that New England’s population was doubling



[figure 19] Franklin’s “Observations Concerning the Increase of Mankind...” in the 1774 edition of *Experiments...*



every twenty-five years. British political theorist Richard Price cited that sermon in his *Observations on Reversionary Payments*, an analysis of British population and insurance published in 1772. Stiles and Price would together succeed in putting Franklin’s calculation into broad circulation, though they sheared off the argument based on nature that had supported his estimate—



[figure 20] Franklin’s Political, Miscellaneous, and Philosophical Pieces, 1779.

no more fennel and polyps. And they would be the last analysts, for some time, to cite Franklin by name.<sup>34</sup>

Though divorced from its author, the thesis that North America’s population doubled every twenty or twenty-five years had a robust career, notably in British publications. *The Annual Register* of 1761 (which ran through six London editions) took an “Extract from a piece written in Pennsylvania in 1751, entitled Observations concerning the Increase of Mankind,” and gave the every-twenty-year estimate of a doubled population. James Burgh, in his *Political Disquisitions* . . . (1774-75) cited the calculation

without giving a source; Burgh also emphasized, in the crucial run-up to the Revolutionary War, that British ministers would be mad to risk losing such a large consumer population. *The Politician's Dictionary, or, a Summary of Political Knowledge* (1775) repeated the estimate without any editorializing. After the war, *A New Geographical, Commercial, and Historical Grammar . . .*, published in Edinburgh in 1790, concluded that America's "superior plenty" explained many differences between Europeans and Americans, not least the rapid growth of inhabitants, who "doubled every 20 years, exclusive of emigration from Europe."<sup>35</sup>

It was perhaps less surprising that Franklin's political arithmetic was much-quoted in the United States, though odd that he was as unlikely to be mentioned by name there as he was in Britain. Without naming him, members of the Continental Congress discussed Franklin's population estimate during the war. They even sent his calculation abroad to their constituents, via a circular

[ vii ]

THE

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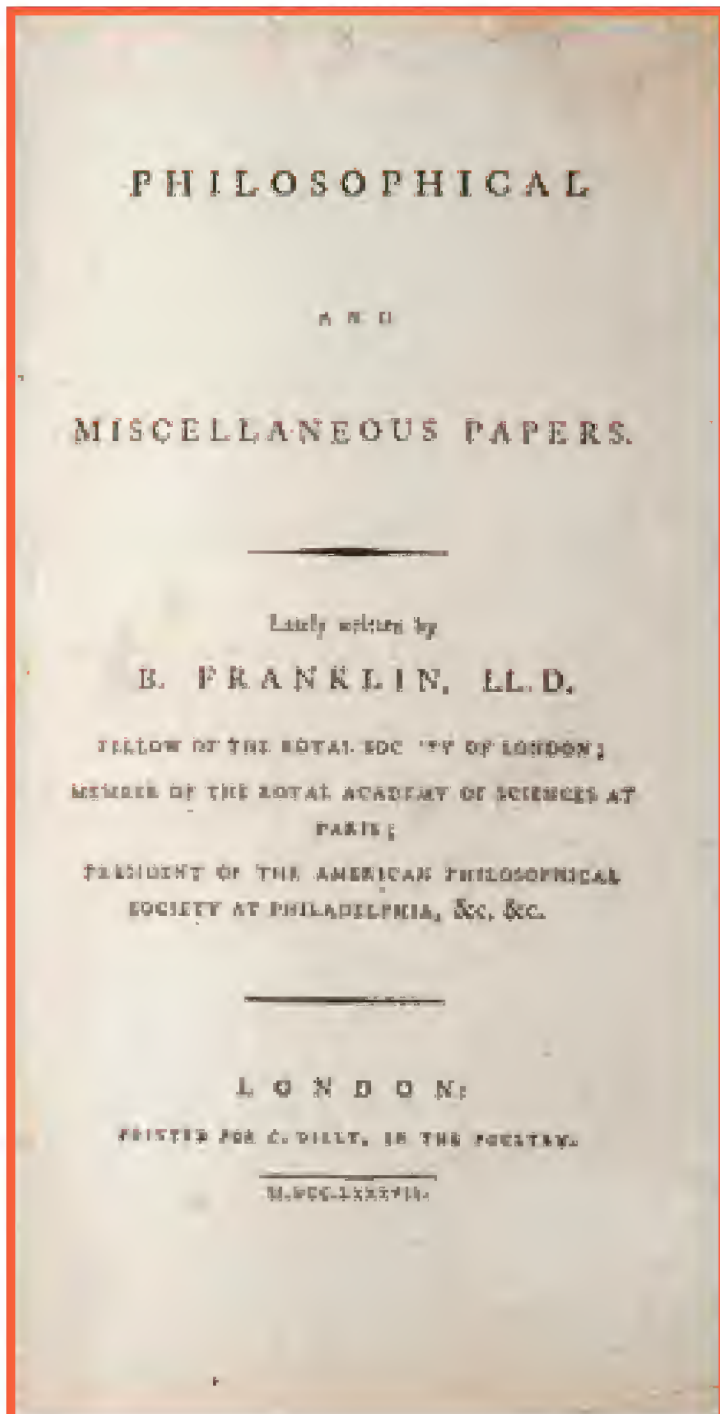
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† : These marks point out places in each division, which are found differently arranged in the body of the work. Accidents or late discovery of the press sometimes have consequences, which may be easily remedied when the work is reprinted. In the mean time, the reader of course takes the order in which the whole is to be read.

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[figure 21] Franklin's Political, Miscellaneous..., 1779.

letter of 1779 meant to reassure citizens that, because their numbers were increasing so quickly, their productive capacity would likewise expand swiftly enough to cover the war debt. Indeed, the authors of the letter rephrased the matter in purely economic terms: “It is well known that the Inhabitants of this country encreased almost in the ratio of compound interest. By natural



[figure 22] *Franklin's Philosophical and Miscellaneous Papers, 1787.*

population they doubled every twenty years.” After the war ended and United States independence was definitively recognized, state histories and compendia continued to celebrate the nation’s rapid population growth, often re-using the comparison between rates of increase for Americans and for compound interest. And, as the first U. S. census of 1790 would reveal, Franklin’s prediction was statistically accurate.<sup>36</sup>

At this point, however, Franklin (who died in 1790) was entirely absent from the discussion. And as the new comparison between people and interest rates (rather than between



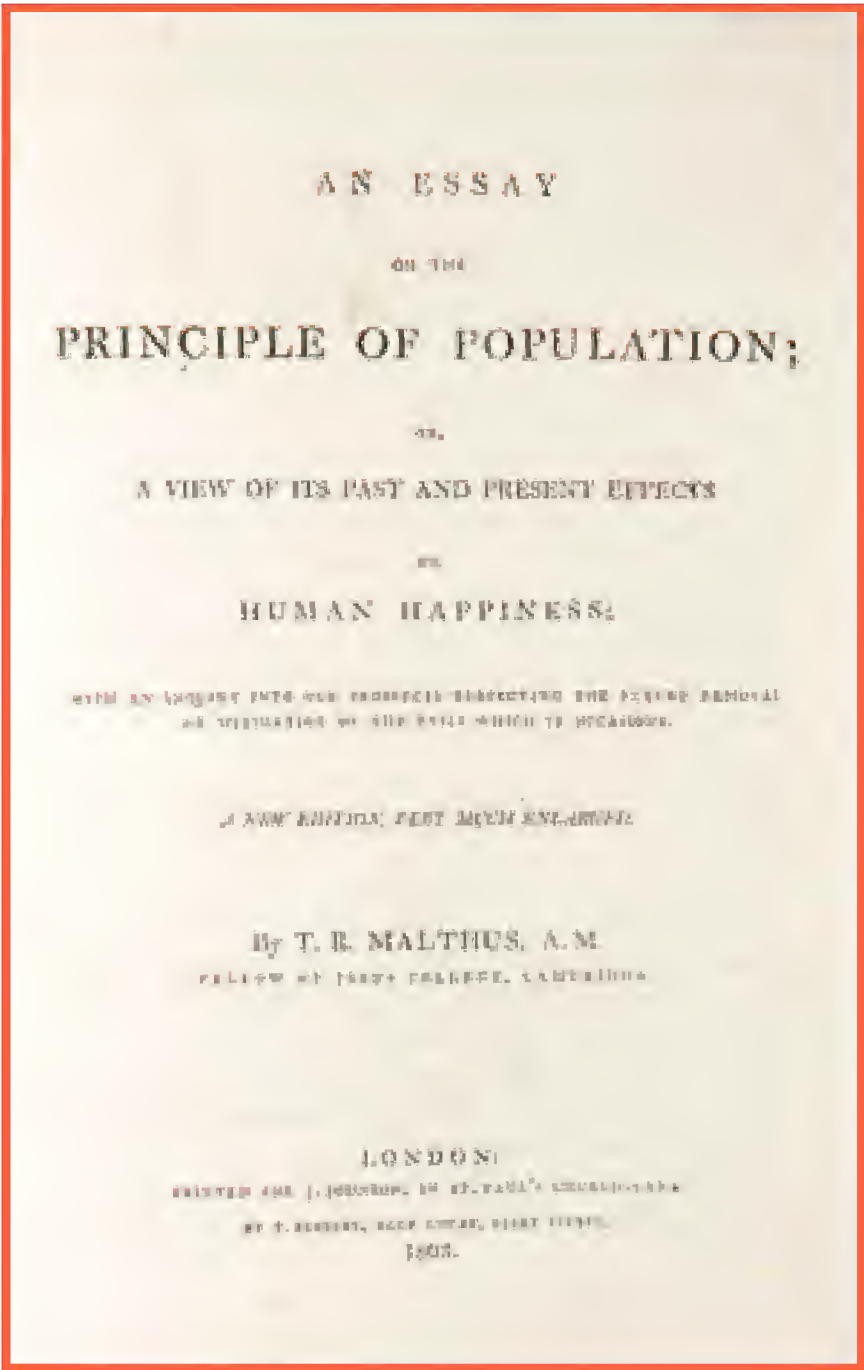
people and other living creatures) showed, his theory had become more strongly rooted in the human sciences than the natural sciences. In this guise, his argument that the means of subsistence was crucial to population growth looped back into natural science and helped to generate the theory of natural selection.

In 1798, Thomas Robert Malthus published his shattering *Essay on the Principle of Population*, which concluded that humans would naturally increase until they ran out of resources necessary for survival. Any population, he explained, “when unchecked, goes on doubling itself every twenty-five years.” Malthus based his supposition on the case of North America’s settler population but cited Richard Price’s *Observations on Reversionary Payments*—not Franklin, whom he had not yet read—as his authority. He also noted that Price himself cited “Dr Style’s pamphlet,” meaning Ezra Stiles’s work, which he did not have in his library. But then Malthus read the 1779 London edition of Franklin’s writings and learned the source of the hypothesis; he acknowledged Franklin in the 1803 edition of *Essay on the Principle of Population* [figure 23]. Still later, in the 1825 edition, he paraphrased Franklin’s passage about fennel increasing unchecked on cleared land and declared the example “incontrovertibly true.”<sup>37</sup>

Malthus’s thesis would thereafter inform nineteenth-century discussions of social policy, of moral philosophy, and of science. His warning about human fecundity went straight into debates over the treatment of the poor in Britain, as scholars have amply documented. Though Franklin had paid little attention to the cultural constraints and personal motives that led people into marriage, Malthus gave those matters close scrutiny. In the

1806 edition of his population analysis, he inserted a recommendation that England's Poor Laws provide no support of children born after a certain date. That measure would, he thought, warn feckless paupers that they needed to consider carefully before they embarked on marriage and reproduction.<sup>38</sup>

If the prospect of rapid increase was a grim one for congested Europe, it was a boon for the colonized neo-Europes, at least from the perspective of the colonizers. Franklin may have been careful to remove his prediction that European settlers would replace American Indians from his essay, but his overall point about competition among different populations within colonized lands was not lost on a later generation of imperialists. A Philadelphia compendium of travel accounts for young readers explained in 1816 that America's



[figure 23] Malthus's *An Essay...*, 1803, the first edition to cite Franklin.

“wandering savages” would inevitably give way to white settlers, whose numbers were “doubled every twenty years.” In 1856, the *Manchester Guardian*, in an article on Australia, exulted that “the population of the Anglo-Saxon colonies, as a general rule, doubled itself once in 25 years.”<sup>39</sup>

But the underlying assumption of such estimates—that people were mere bundles of physical impulses, especially hunger and lust—remained controversial. An enthusiastic if not particularly helpful endorsement came from adherents of the “unrespectable radicalism” of Regency and early Victorian England. These new libertines blended hostility to orthodox religion and religious authority (as Franklin had done in his *Dissertation on Liberty and Necessity*) with a hedonistic sexuality. They read Malthus as a prescription rather than a description. An anonymous poem, *Don Leon* (1866), falsely attributed to Lord Byron (whose *Don Juan* had been pirated and reprinted as a libertine how-to guide), claimed Malthus as a scientist of sexual instinct: “Come, Malthus, and in Ciceronian prose / Tell how a rutting Population grows.”<sup>40</sup>

That lurid image of human increase haunted Victorian men of science, particularly the two modern theorists of evolution, Alfred Russel Wallace and Charles Darwin. Wallace had read Malthus’s *Essay on the Principle of Population* in the 1840s and recollected it suddenly in 1858, while fever-ridden during his breakthrough scientific expedition in Malaysia. Because Malthus’s text helped Wallace to describe why some plants and animals thrived while others did not, he described it as “perhaps the most important book I read,” the main principle of which he retained as “a permanent possession.”<sup>41</sup>



Charles Darwin [figure 24] acknowledged a similar debt. He recounted how, in 1838, he “happened to read for amusement Malthus on *Population*.” His own scientific research had already inclined him to “appreciate the struggle for subsistence” and it struck him “that under these circumstances favourable variations would tend to be preserved, and unfavourable ones to be destroyed.” In his *On the Origin of Species* (1859) [figure 25], Darwin concluded that the struggle for existence, and consequent ability to reproduce, underlay not only changes in plant and animal species, but their possible extinction. In his *Descent of Man* (1871), he hypothesized that changes in species had eventually given rise to humans, who were descended from animal



[figure 24] Charles Robert Darwin, c. 1860.

ancestors. And he worried that his evidence would question human faith in God: what kind of Creator had designed nature along such ruthless, materialistic lines, without reserving to humanity any special status or destiny? Darwin did, however, concede that human reason and culture might constrain behavior (including sexual behavior) “much more” than “natural selection” did. As when Malthus had insisted that human laws might govern reproduction, Darwin gave humans more power over nature than Franklin had done.<sup>42</sup>

Although Wallace did not remark on the connection between Franklin and Malthus, Darwin did. The famous Philadelphian had, in fact, been a friend of Darwin's family. Franklin had known both of Charles Darwin's grandfathers, Erasmus Darwin [figure 26] and Josiah Wedgwood; the latter had made portrait medallions of Franklin in the famous Wedgwood jasperware [figure 27]. Franklin had also known Charles Darwin's father, Robert Waring Darwin—the young Englishman visited him in Paris just after the American Revolution, when he crossed the Channel to study medicine. Only one of Franklin's letters to any of the family had survived, but Robert Waring Darwin had evidently regaled his children with tales of Dr. Franklin in Paris. And Charles Darwin's surviving library includes an edition of Malthus, marked with the year "1841" (if the year of Darwin's acquisition, this is not the copy he read in 1838). The first volume is underscored in several places, including Malthus's quotation of Franklin: "were the face of the earth vacant of other plants it might be gradually sowed and overspread with one kind only, as for instance with fennel."<sup>43</sup>

a d | b c

When Darwin's library was cataloged in the early twentieth century, that underscored phrase puzzled Francis Darwin, the great man's son. In his introduction to the published catalog, he concluded: "Why Dr Franklin chooses fennel for his mundane plant is not clear." Thus had the natural science origins of Franklin's political arithmetic faded from view over the century and a half since he had written his *Observations Concerning the Increase of Mankind*. That may have been the price of Franklin's care to conceal his original radical idea, about breaching the barrier between

ON  
THE ORIGIN OF SPECIES

BY MEANS OF NATURAL SELECTION,

OR THE  
PRESERVATION OF FAVOURED RACES IN THE STRUGGLE  
FOR LIFE.

By CHARLES DARWIN, M.A.,

FELLOW OF THE ROYAL, GEOLOGICAL, LINNEAN, ETC., SOCIETIES;  
AUTHOR OF 'JOURNAL OF RESEARCHES DURING H. M. S. BEAGLE'S VOYAGE  
ROUND THE WORLD.'

LONDON:  
JOHN MURRAY, ALBEMARLE STREET.  
1859.

*[figure 25] Darwin's On the Origin of Species, 1859.*



humans and animals, even as he made it into the foundation of his political arithmetic. In this way, an American idea, about the rapidity with which settler populations increased in the new world, made its way first into the colonial struggle against Great Britain, next into Malthusian political economy, then into nineteenth-century analyses of population and empire, and finally into Darwin's theory of natural selection.<sup>44</sup>

Many Americans now regard the American Founders as men of faith; many dismiss evolution as a foreign import, alien to the Christian foundations of the United States.

Both contentions simplify the past, and each particularly misrepresents Franklin, who wrote first a satirical analysis of God as the creator of humans who were, like animals, motivated by the pursuit of pleasure and avoidance of pain, and then a serious argument that, like other living beings, humans would reproduce so long



*[figure 26] Erasmus Darwin, 1807.*

as they had the means of subsistence to do so. In the service of the American revolt against Britain, Franklin patriotically exported his “mortifying and distasteful” hypotheses about humanity’s material needs to Europe, where they had a fruitful if anonymous afterlife in the creation of modern evolutionary science before making their way back across the Atlantic Ocean. Franklin’s science for “new Countries” had become a science for a new era and, in the process, had re-animated the controversy over materialist

visions of humanity  
he had fled when  
he disavowed his  
youthful essay in  
philosophy.

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*[figure 27] Wedgwood's portrait medallion of Franklin, c. 1776.*

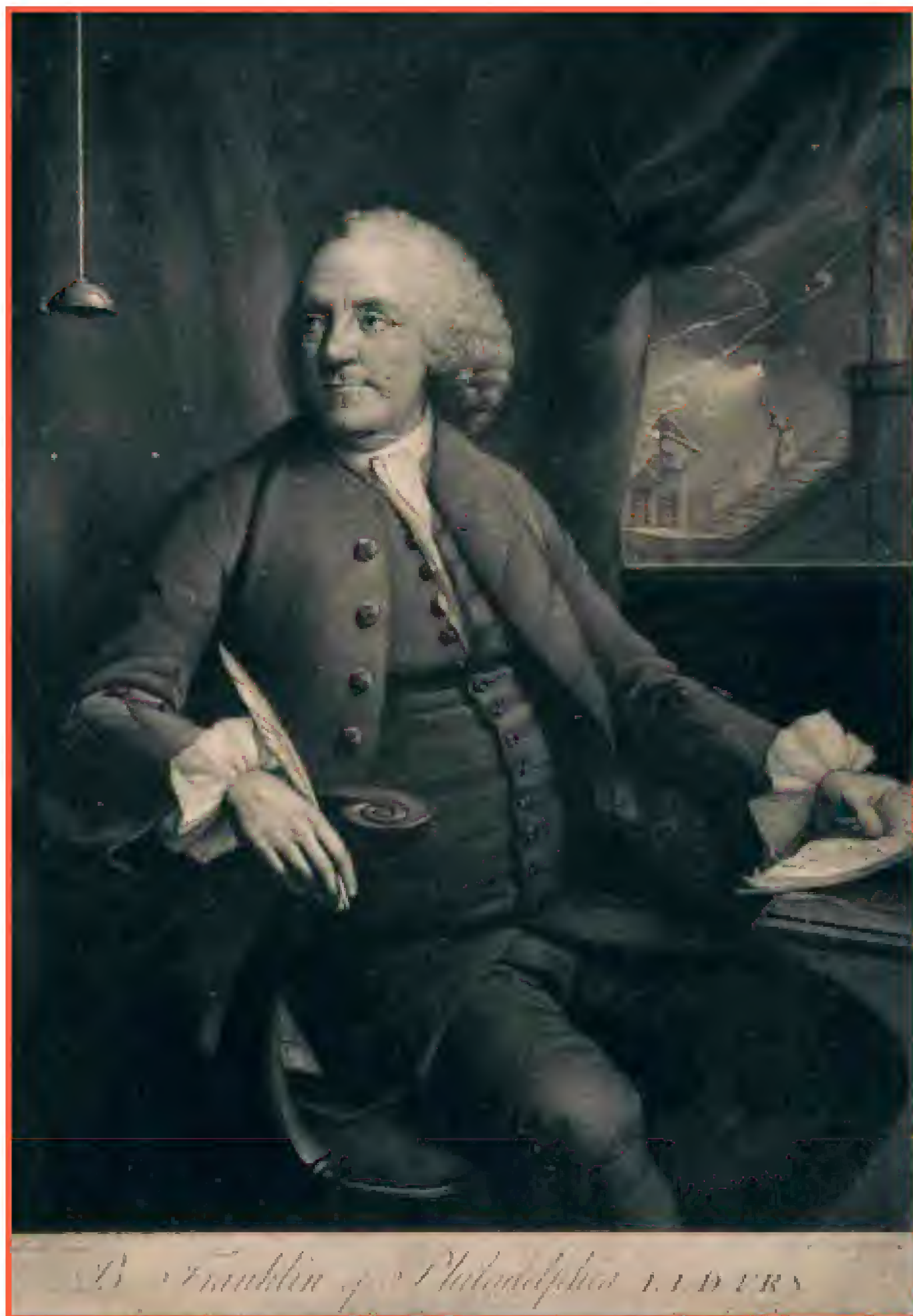
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- 12 Ibid.
- 13 Benjamin Franklin, "Articles of Belief and Acts of Religion," Nov. 20, 1728, PBF, I, 105.
- 14 *Autobiography*, 96, 96n; J. A. Leo Lemay, *The Life of Benjamin Franklin*, vol. II: *Printer and Publisher, 1730-1747* (Philadelphia: University of Pennsylvania Press, 2006), 270.
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- 16 Chaplin, *First Scientific American*, 49-50, 80-83.
- 17 *Poor Richard Improved . . . 1750* (1749), PBF, III, 440-41.
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- 19 [Benjamin Franklin], "To the Printers of the Gazette," *Pennsylvania Gazette*, May 9,



*[figure 28] Benjamin Franklin, 1763.*

1751, PBF, IV, 132-33.

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- 21 *Ibid.*, 234.
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- 24 Franklin, "Increase of Mankind," 229, 233.
- 25 *Ibid.*, 233.
- 26 *Ibid.*, 233-34.
- 27 Catherine Wilson, *The Invisible World: Early Modern Philosophy and the Invention of the Microscope* (Princeton: Princeton University Press, 1995), esp. ch. 5; Chaplin, *First Scientific American*, 59-60.
- 28 *Poor Richard Improved . . . 1751* (1750), *PBF*, IV, 90, 91, 93 (italics added).
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- 30 Thomas, *Man and the Natural World*, 121-41. While Franklin knew about Linnaeus's work, there is no evidence he ever read La Mettrie.
- 31 Benjamin Franklin to Joseph Priestley, June 7, 1782, *PBF*, XXXVII, 444-45; Chaplin, *First Scientific American*, 338-39.
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**B.FRANKLIN, L.L.D. F.R.S.**

*Born at Boston in New England, Jan 17<sup>th</sup> 1706.*

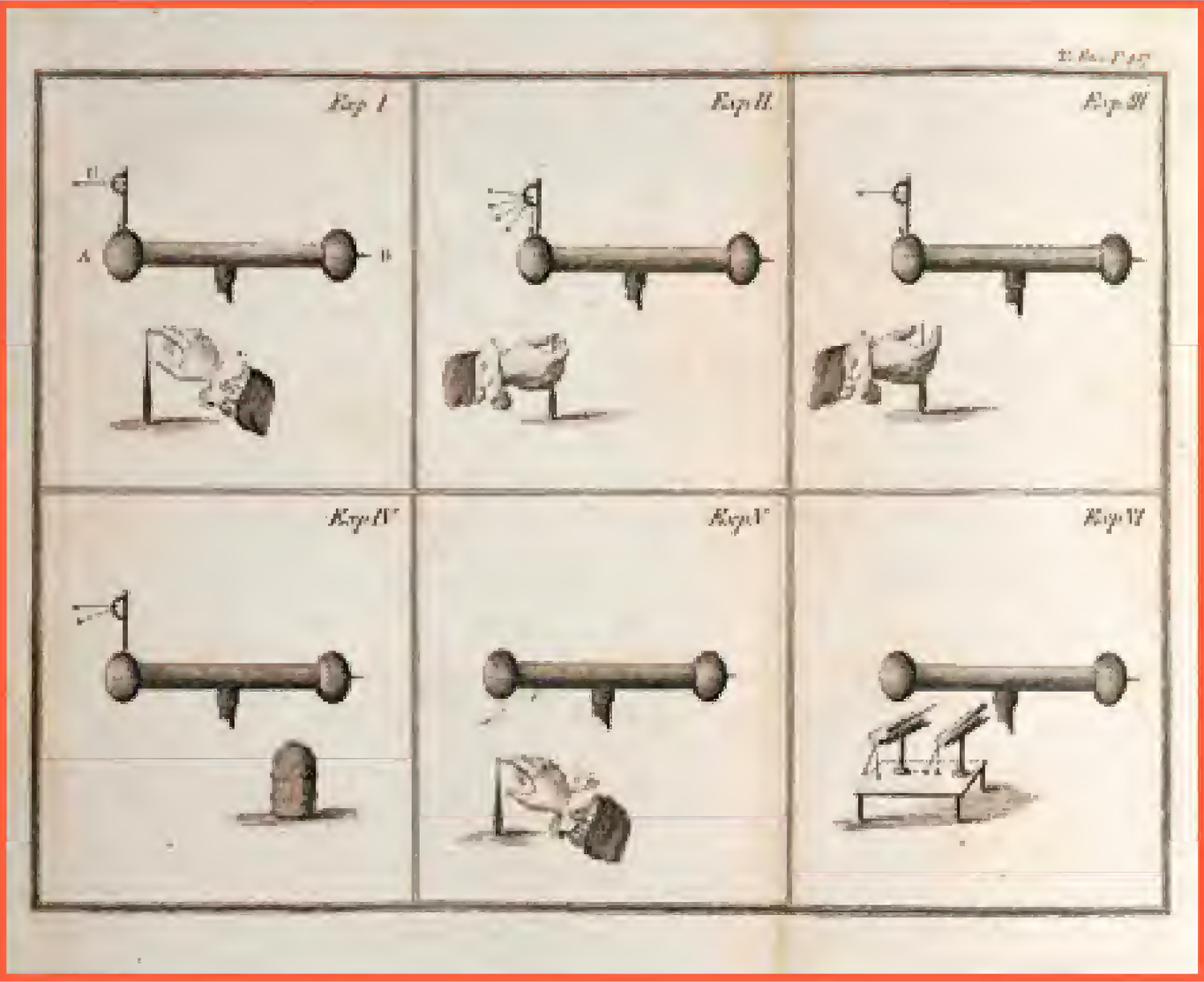
**NON SORDIDUS AUCTOR NATURÆ VERIQUE.**

[figure 29] From *Franklin's Political, Miscellaneous, and Philosophical Pieces*, 1779.

- 36 *A Circular Letter from the Congress of the United States of America to their Constituents* ([Boston], [1779?]), 8; "A Citizen," *Observations on the Peculiar Case of the Whig Merchants, Indebted to Great Britain at the Commencement of the Late War . . .* (New York, 1785), 8; David Ramsay, *The History of the Revolution of South-Carolina* (Trenton, 1785), II, 419; *Collections of the Massachusetts Historical Society, for the Year 1793* (Boston, 1793), II, 174; Thomas Pemberton, *An Historical Journal of the American War. Extracted from the Publications of the Massachusetts Historical Society* ([Boston], 1795), 126; *Journals of Congress: Containing their Proceedings from January 1, 1779, to January 1, 1780* (Philadelphia, 1800), V, 262; Zirkle, "Benjamin Franklin, Thomas Malthus and the United States Census," 59-60, 60n.
- 37 T. R. Malthus, *An Essay on the Principle of Population . . .* (London, 1798), 21, 105-06, 185; Conway Zirkle, "Natural Selection before the *Origin of Species*," *American Philosophical Society Proceedings* 84 (1941), 71-123; Patricia James, *Population Malthus: His Life and Times* (London: Routledge and Kegan Paul, 1979), esp. 106-07.
- 38 James, *Population Malthus*, 130-35.
- 39 Charles Lloyd, *Travels at Home, and Voyages by the Fire-side, for the Instruction and Entertainment of Young Persons*, 2 vols. (Philadelphia, 1816), II, 293; "Steam Communication with Australia," *Manchester Guardian*, Apr. 16, 1856.
- 40 Iain McCalman, "Unrespectable Radicalism: Infidels and Pornography in Early Nineteenth-Century London," *Past & Present* no. 104 (1984), esp. 99-100; *Don Leon* (London, 1866), line 253.
- 41 R. M. Young, "Malthus and the Evolutionists," *Past & Present* no. 98 (1969), 109-45; James Moore, "Wallace's Malthusian Moment: The Common Context Revisited," in *Victorian Science in Context*, ed. Bernard Lightman (Chicago: University of Chicago Press, 1997), 290-311; Michael Shermer, *In Darwin's Shadow: The Life and Science of Alfred Russel Wallace* (Oxford: Oxford University Press, 2002), 53 (quotation), 82, 112-14; Martin Fichman, *An Elusive Victorian: The Evolution of Alfred Russel Wallace* (Chicago: University of Chicago Press, 2004), 16, 70-71, 96-98.
- 42 Charles Darwin, *The Autobiography of Charles Darwin*, ed. Nora Barlow (London: Collins, 1958), 120; Peter Vorzimmer, "Darwin, Malthus, and the Theory of Natural Selection," *Journal of the History of Ideas* 30 (1969), 537 n.20; Janet Browne, *Charles Darwin: A Biography*, vol. I, *Voyaging* (Princeton: Princeton University Press, 1995), 385-90; Charles Darwin, *The Descent of Man*, 2 vols. (London: John Murray, 1871), II, 404.
- 43 It is possible that Wallace read the first edition of Malthus, which did not mention Franklin. The surviving letter to the Darwin clan is Benjamin Franklin to Josiah

Wedgwood, May 15, 1787 ([www.franklinpapers.org](http://www.franklinpapers.org)), though enough outgoing letters from Wedgwood and from Erasmus Darwin to Franklin have survived to indicate a more extensive correspondence; Robert Waring Darwin to Benjamin Franklin [c. 1780s], Franklin Papers, American Philosophical Society; Charles R. Darwin to Charles Eliot Norton, Apr. 30, 1881, Papers of Charles Eliot Norton, MS American 1088.14, Houghton Library, Harvard University; Darwin to Norton, June 1, 1881, *ibid.*; 1969.

44 H. W. Rutherford, *Catalogue of the Library of Charles Darwin...*, with an introduction by Francis Darwin (Cambridge: Cambridge University Press, 1908), xi.



[figure 30] From *Franklin's Political, Miscellaneous...*, 1779.



## a images C

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- [Title page] Benjamin Franklin, by Joseph Siffred Duplessis. Oil on canvas, c. 1785. National Portrait Gallery, Smithsonian Institution; gift of the Morris and Gwendolyn Cafritz Foundation.
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- [Figure 4] Sir William Petty, by John Smith, after John Closterman. Mezzotint, 1696.
- [Figure 5] William Petty, *Several Essays in Political Arithmetic*, (London, 1699).
- [Figure 6] [Benjamin Franklin], *A Dissertation on Liberty and Necessity, Pleasure and Pain* (London, 1725). Courtesy of the John Carter Brown Library, Brown University.
- [Figure 7] [Benjamin Franklin], *A Dissertation on Liberty and Necessity, Pleasure and Pain* (London, 1725), 32. Courtesy of the John Carter Brown Library, Brown University.
- [Figure 8] Marcus Elieser Bloch, *Ichtyologie, ou Histoire naturelle, générale et particulière des poissons* (Berlin, 1785-97), plate LXIV.
- [Figure 9] Mark Catesby, *The Natural History of Carolina, Florida and the Bahama Islands* (London, 1731-43), plate 41.
- [Figure 10] Benjamin Franklin, by Michel Honoré Bounieu and Juste Chevillet after Jean-Antoine Houdon. Engraving, c.1780.
- [Figure 11] Abraham Trembley, *Mémoires pour servir à l'histoire d'un genre de polypes d'eau douce, à bras en forme de cornes* (Leiden, 1744), [149].
- [Figure 12] Robert Hooke, *Micrographia: or, Some Physiological Descriptions of Minute Bodies Made by Magnifying Glasses...* (London, 1665).
- [Figure 13] George Adams, *Micrographia illustrata: or, The Microscope Explained...* (London, 1771).
- [Figure 14] George Adams, *Micrographia illustrata: or, The Microscope Explained...* (London, 1771), plate 1.
- [Figure 15] George Adams, *Micrographia illustrata: or, The Microscope Explained...* (London, 1771), plate 47.
- [Figure 16] Benjamin Franklin, *Experiments and Observations on Electricity: Made at Philadelphia in America...* (London, 1751).
- [Figure 17] Benjamin Franklin, *Œuvres de M. Franklin...* (Paris, 1773).
- [Figure 18] Benjamin Franklin, *Experiments and Observations on Electricity...*

- (London, 1774).
- [Figure 19] “Observations Concerning the Increase of Mankind,” from Benjamin Franklin, *Experiments and Observations on Electricity*... (London, 1774), 205.
- [Figure 20] Benjamin Franklin, *Political, Miscellaneous, and Philosophical Pieces*... (London, 1779).
- [Figure 21] Benjamin Franklin, *Political, Miscellaneous, and Philosophical Pieces*... (London, 1779), vii.
- [Figure 22] Benjamin Franklin, *Philosophical and Miscellaneous Papers* (London, 1787).
- [Figure 23] T. R. Malthus, *An Essay on the Principle of Population, or, A View of its Past and Present Effects on Human Happiness*... (London, 1803).
- [Figure 24] Charles Darwin, by Ernest Edwards, London. Photograph, c.1866.
- [Figure 25] Charles Darwin, *On the Origin of Species by Means of Natural Selection* (London, 1859).
- [Figure 26] Erasmus Darwin, by Moses Haughton, after J. Rawlinson. Stipple engraving, 1807.
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- [Figure 29] Benjamin Franklin, *Political, Miscellaneous, and Philosophical Pieces*... (London, 1779), frontispiece.
- [Figure 30] Benjamin Franklin, *Political, Miscellaneous, and Philosophical Pieces*... (London, 1779), plate facing p. 487.

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